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of the energy necessary to maintain any system through such an endless cycle of changes? A few years ago not even the hint of an answer would have been forthcoming, but the recent revolutionary discoveries of chemists and physicists as to the constitution of matter suggest the idea that the internal energies of the atoms, especially under such conditions as those existing in the Sun or a star, will prove adequate to all the requirements.

ASTRONOMICAL OBSERVATIONS IN 1905.

MADE BY TORVALD KÖHL, AT ODDER, DENMARK.

VARIABLE STARS.

Z Cygni.[1]

Jan.	1:	Z < e.
	7:	id.
	13:	= e.
	22:	= d.
Feb.	2:	= c.
	12:	= b.
	26:	= a.
Mar.	2:	1 step > a.
May	5:	= d.
	13:	< d. > e.
	25:	= e.
Aug.	6:	1 step < e.
	11:	< e.
	17:	id.
	20:	id.
Aug.	21:	id.
	24:	id.
Sept.	15:	< e.
	17:	id.
Oct.	1:	id.
	28:	> c. < b.
Nov.	18:	= a.
	27:	1 step > a.
	30:	= a.
Dec.	16:	id.
	18:	< a. > b′.
	26:	id.
	31:	id.

S Ursæ Majoris.[2]

Jan.	1:	S = e.
	5:	1 step > d.
	7:	= d.
	10:	2 steps > d.
	12:	= d.
	13:	1 step > d.
	22:	2 steps > d.
	31:	= d.
Feb.	2:	id.
	12:	id.
	26:	2 steps < e.
Mar.	2:	id.
	24:	1 step > f′.
Apr.	1:	= f.
	3:	< f. > g.

[1] *Vide* the sketch in the *Publications* A. S. P., No. 100, page 16.

[2] *Vide* the sketch in the *Publications* A. S. P., No. 73, page 56.

Apr.	8:	= g.
	10:	id.
	22:	id.
	29:	invisible.
May	5:	very faint.
	13:	invisible.
	25:	< g.
June	8:	= f.
	11:	> f. < e.
July	8:	> e. < d.
July	19:	= d.
	28:	> d. < c.
Aug.	11:	3 steps > d.
	15:	id.
	19:	id.
	21:	1 step > d.
	24:	3 steps > d.
Sept.	15:	2 steps > d.
	17:	id.
	21:	1 step > d.
	30:	< d. > e.
Oct.	9:	= e.
	15:	2 steps < e.
	19:	2 steps > f.
	28:	= f.
Nov.	10:	< f. > g.
	18:	1 step < g.
	24:	id.
	27:	id.
	30:	id.
Dec.	16:	invisible.
	18:	id.
	26:	= g.
	31:	id.

T Ursæ Majoris.[1]

Jan.	1:	*T* < g.
	7:	1 step < g.
	10:	= f.
	12:	> f. < e.
	13:	id.
	22:	1 step > e.
	31:	= c.
Feb.	2:	1 step > b.
	12:	1 step > a.
	26:	3 steps > a.
Mar.	2:	5 steps > a.
	24:	2 steps > a.
Apr.	1:	= a.
	3:	< a. > b.
	10:	id.
	12:	< b. > c.
	22:	= c.
	29:	= d.
May	5:	< d. > e.
	13:	< e. > f.
	25:	= g.
Aug.	11:	invisible.
	15:	id.
	19:	id.
	21:	id.
	24:	id.
Sept.	17:	< g.
	21:	id.
	30:	> f. < e.
Oct.	9:	> e. < d.
	15:	= d.
	19:	1 step > c.
	28:	> c. < b.
Nov.	10:	id.
	18:	1 step > b.
	24:	id.
	27:	= b.
	30:	id.
Dec.	16:	< b. > c.
	18:	id.
	26:	< c. > d.
	31:	id.

[1] *Vide* the sketch in the *Publications* A. S. P., No. 22, page 63.

W Pegasi.[1]

Jan.	1:	*W* = f.
	7:	id.
	10:	id.
	13:	1 step > f.
	22:	= e.
	31:	= d.
Feb.	2:	2 steps > d.
	12:	= c.
	26:	< b.; > c.
Aug.	6:	invisible.
	19:	id.
	21:	< n (a star between *W* and *h*)
	24:	id.
	25:	id.
Sept.	17:	id.
	30:	id.
Oct	1:	= n.
	9:	id.
	15:	id.
	28:	= g.
Nov.	10:	> g.; < f.
	18:	1 step < f.
	24:	id.
	27:	id.
	30:	id.
Dec.	16:	> f.; < e.
	26:	id.
	31:	1 step > e.

SS Cygni.[2]

Jan.	1..	6h P.M.	< f.
		8½	id.
	7..	6¼	= f.
	10..	6	3 steps > c.; 1 step < b.
		6¾	2 steps > c.; 2 steps < b.
	12..	6½	1 step > c.; 3 steps < b.
	13..	5¾	1 step < c.
	22..	6½	= g (the faint companion-star towards east.)
	31..	6½	invisible.
Feb.	2..	8	= g.
	12..	8½	< g.
	26..	8	= b.
Mar.	2..	9	< b.; > c.
	24..	8½	< g
May	5..	10	= d.
May	13..	11½	< f.
	25..	11½	id.
June	10..	12½	< b.; > c.
July	19..	11	invisible.
Aug.	6..	11½	1 step > e.
	10..	12½	= g.
	19..	11	invisible.
	20..	10	= g.
	21..	10	< g.
	24..	11	= g.
	25..	10	id.
Sept.	15..	8½	> c.; < b.
	17..	8½	id.
	21..	9	< c.; > d.
	30..	8½	= f.
Oct.	1..	8½	= g.

[1] *Vide* the sketch in the *Publications* A. S. P., No. 60, page 23.
[2] *Vide* the sketch in the *Publications* A. S. P., No. 100, page 18.

Oct. 9..	8	< g.	Nov. 27..	7	1 step > c.
15..	6½	id.	30..	5¾	= c.
28..	8	> d. < c.	Dec. 16..	5½	< f.
Nov. 10..	6½	= g.	18..	6½	< g.
18..	6¼	< g.	26..	6	id.
24..	8½	= c.	31..	7	= g.

Y Tauri (B. D. + 20°.1083).

The estimations in such a case, where one of the stars is red, are made easier by drawing out the ocular, the screw being given one turn. Then the star appears as a great disk. In the year 1905 this red star has shown only slight fluctuations near the brightness $8^m.2$ of the star b = B. D. + 20°.1073.

Jan. 1:	*Y* = b.	Oct. 28:	> b.
7:	id.	Nov. 10:	> b, almost = B. D. + 20°.1095 ($7^m.4$)
13:	id.	24:	= b.
22:	id.	Dec. 16:	> b.
Feb. 2:	id.	17:	a little > b.
26:	< b.	18:	id.
Mar. 24:	a little < b.	26:	id.
Apr. 1:	= b.	31:	id.

Nova Persei.

I have found no remarkable fluctuations, the star being almost stable between 10m.4 and 10m.6.

FIREBALLS.

Several years ago I directed attention to the fact that fireballs may be expected on December 12th. In my great catalogue on meteors from 1875-1905 this date recurs eight times. In this period of thirty-one years fireballs appeared

On Dec. 9 .... 1 year
" 10 .... 3 "
" 11 .... 4 "
" 12 .... 8 "
" 13 .... 4 "
" 14 .... 1 "

FIREBALLS.

In the past year twenty-seven fireballs have been seen from stations in Denmark and surrounding countries, as follows:[1]

No.	Time.	Beginning.	End.	Mag.	Station.	Notes.
	h m	α δ	α δ			
1	Jan. 16, 7 50 P. M.	60° + 40°	82° + 3°	....	Holte	The meteor exploded in two pieces, following each other at a distance of 1°. The foremost was twice as long as the other, and remained visible an instant after the latter had disappeared.
2	Feb. 11, 11 25	....	Western sky	....	Christiania and several places in Denmark..............	Exploding fireball lighted up the whole region in spite of moonshine. Five reports.
3	Mar. 20, 0 15	....	....	...	Frederikstad and several other places in Norway	Gigantic fireball at *noon* over southeastern Norway. In Frederikstad the people were frightened by the loud detonation and ran out of the houses, thinking an earthquake had taken place. Somebody thought of a powder explosion. The fireball was seen in spite of the dazzling sunshine as a sparkling exploding meteor, leaving a large train for a moment. It disappeared 44 km. above a spot situated 18 km. NNE. from the named city, the path in the atmosphere being very steep, forming an angle of about 40° with the vertical. The fragments of the meteor have probably fallen into the sea. Twenty-one reports.
4	July 10, 12 27	NW.	....	....	Copenhagen....	Train, visible for four minutes, was straight in two, and undulated in the last two minutes.
5	Sept. 9, 7 41	15° South f. W. 55° altitude	45° South f. W. 40° altitude	¼ ☾	Vejle	Exploding meteor, one of the five or six pieces being green. Duration 4-5 seconds.
6	Dec. 12, 5 0	NE.	WSW.	....	Nordby (Fanö).	A large, slowly-moving meteor. Suddenly a train appeared, a cracking detonation was heard, also a plunge in the sea, and circular waves were seen, while the meteor was still visible in the sky. Duration 15 seconds.
7	Dec. 17, 9 33	NW.	270° + 35°	⅛ ☾	Wesselburnerkoog (Holstein)..........	A yellow-white, at last red, fireball with a short tail. Explosion. Duration 1-2 seconds.

[1] The details of the seven most interesting of these meteors are here given.

SHOOTING STARS.

As usual, in the period August 9th-12th corresponding observations were arranged for from stations in Denmark. At six stations 59 paths of shooting-stars were mapped, but only three proved suitable for calculation. These three meteors have given the following results:—

FOR OBSERVATION.

No.	Time	Station.	Beginning.	Ending	Mag.	Observer.
	h m s		° °	° °		
1	Aug. 10, 10 17 50 P. M.	Ribe	10 + 51	355 + 47.5	♃	V. DOHN.
		Kolding		305 + 55	♃	H. NIELSEN.
		Odder	292 + 46.5	268 + 18	♃	T. KÖHL.
2	Aug. 10, 11 14 30	Ribe	356 + 27	349 + 26 5	3	V. DOHN.
		Odder	336 + 22	320 + 17	3	T KÖHL.
3	Aug. 10, 11 43 15	Ribe	23 + 25	17 + 18.5	2	V DOHN.
		Odder	346 + 17	338 + 6.5	2	T KÖHL.

FOR CALCULATION.

No.	Beginning			Ending.			Real Length of the Path.	Radiant.
	h	λ	ϕ	h	λ	ϕ	β	*AR Decl.*
		° ′	° ′		° ′	° ′		° °
1	103	2 21	55 49	70	2 54	55 31	60	36 + 52
2	235	0 2	54 47	168	1 28	54 50	116	10 + 27
3	95	1 12	55 22	82	1 24	55 9	32	86 + 52

In all cases Ribe-Odder has been used. As in the first case the end-point of the path was observed from three stations, two other combinations might have been used, and have given the following results:—

Stations.	Ending. h	λ	ϕ
Kolding-Odder	70	2° 56′	55° 30′
Ribe-Kolding	68	2 54	55 30

h and β are expressed in kilometers; λ is west longitude from Copenhagen; ϕ is north latitude; h is the altitude of the meteor above the Earth's surface.